

IN THE CLAIMS:

1. A copolymer comprising (a) a plurality of constitutional units that correspond to one or more olefin monomer species and (b) a plurality of constitutional units that correspond to one or more protected or unprotected hydroxystyrene monomer species.
2. The copolymer of claim 1, wherein said one or more olefin monomer species are selected from isomonoolefins containing 4 to 18 carbon atoms per molecule and multiolefins containing 4 to 14 carbon atoms per molecule.
3. The copolymer of claim 1, wherein said one or more olefin monomer species are selected from isobutylene, 2-methylbutene, isoprene, 3-methyl-1-butene, 4-methyl-1-pentene and beta-pinene.
4. The copolymer of claim 1, wherein said one or more olefin monomer species comprise isobutylene.
5. The copolymer of claim 1, wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a hydroxystyrene species.
6. The copolymer of claim 1, wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a protected hydroxystyrene monomer species.
7. The copolymer of claim 6, wherein said protected hydroxystyrene monomer species are selected from tert-butyl protected hydroxystyrene, benzyl protected hydroxystyrene, cyclohexyl protected hydroxystyrene, neopentyl protected hydroxystyrene, acetyl protected hydroxystyrene and tert-butyldimethylsilyl protected hydroxystyrene.
8. The copolymer of claim 1, wherein said one or more olefin monomer species comprise isobutylene, and wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a hydroxystyrene species.

9. The copolymer of claim 1, wherein said one or more olefin monomer species comprise isobutylene, and wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a protected hydroxystyrene monomer species.

10. The copolymer of claim 1, wherein said copolymer is a block copolymer comprising: (a) an olefin block that comprises a plurality of constitutional units corresponding to said one or more olefin monomer species and (b) a styrenic block that comprise a plurality of constitutional units corresponding to said one or more protected or unprotected hydroxystyrene monomer species.

11. The copolymer of claim 10, wherein said one or more olefin monomer species are selected from isomonoolefins containing 4 to 18 carbon atoms per molecule and multiolefins containing 4 to 14 carbon atoms per molecule.

12. The copolymer of claim 10, wherein said one or more olefin monomer species are selected from isobutylene, 2-methylbutene, isoprene, 3-methyl-1-butene, 4-methyl-1-pentene and beta-pinene.

13. The copolymer of claim 10, wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a hydroxystyrene species.

14. The copolymer of claim 10, wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a protected hydroxystyrene monomer species.

15. The copolymer of claim 14, wherein said protected hydroxystyrene monomer species are selected from tert-butyl protected hydroxystyrene, benzyl protected hydroxystyrene, cyclohexyl protected hydroxystyrene, neopentyl protected hydroxystyrene, acetyl protected hydroxystyrene and tert-butyldimethylsilyl protected hydroxystyrene.

16. The copolymer of claim 10, wherein said one or more olefin monomer species comprise isobutylene, and wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a hydroxystyrene species.

17. The copolymer of claim 10, wherein said one or more olefin monomer species are selected from isomonoolefins containing 4 to 18 carbon atoms per molecule and multiolefins containing 4 to 14 carbon atoms per molecule, and wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a protected hydroxystyrene monomer species.

18. The copolymer of claim 17, wherein said one or more olefin monomer species comprise isobutylene, and wherein said protected hydroxystyrene monomer species are selected from tert-butyl protected hydroxystyrene, benzyl protected hydroxystyrene, cyclohexyl protected hydroxystyrene, neopentyl protected hydroxystyrene, acetyl protected hydroxystyrene and tert-butyldimethylsilyl protected hydroxystyrene.

19. The copolymer of claim 10, wherein said block copolymer is of the formula $X(\text{POL-C-PST})_n$, where X corresponds to an initiator species, C corresponds to a capping species, POL is said olefin block that comprises a plurality of constitutional units corresponding to said one or more olefin monomer species, PST is said styrenic block that comprise a plurality of constitutional units corresponding to said one or more protected or unprotected hydroxystyrene monomer species, and n is a positive whole number ranging from 1 to 5.

20. The copolymer of claim 19, wherein said one or more olefin monomer species are selected from isomonoolefins containing 4 to 18 carbon atoms per molecule and multiolefins containing 4 to 14 carbon atoms per molecule.

21. The copolymer of claim 19, wherein said one or more olefin monomer species are selected from isobutylene, 2-methylbutene, isoprene, 3-methyl-1-butene, 4-methyl-1-pentene, beta-pinene.

22. The copolymer of claim 19, wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a hydroxystyrene species.
23. The copolymer of claim 19, wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a protected hydroxystyrene monomer species.
24. The copolymer of claim 23, wherein said protected hydroxystyrene monomer species is selected from tert-butyl protected hydroxystyrene, benzyl protected hydroxystyrene, cyclohexyl protected hydroxystyrene, neopentyl protected hydroxystyrene, acetyl protected hydroxystyrene and tert-butyldimethylsilyl protected hydroxystyrene.
25. The copolymer of claim 19, wherein said one or more olefin monomer species comprise isobutylene, and wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a hydroxystyrene species.
26. The copolymer of claim 19, wherein said one or more olefin monomer species comprise isobutylene, and wherein said one or more protected or unprotected hydroxystyrene monomer species comprise a protected hydroxystyrene monomer species.
27. The copolymer of claim 26, wherein said protected hydroxystyrene monomer species is selected from tert-butyl protected hydroxystyrene, benzyl protected hydroxystyrene, cyclohexyl protected hydroxystyrene, neopentyl protected hydroxystyrene, acetyl protected hydroxystyrene and tert-butyldimethylsilyl protected hydroxystyrene.
28. The copolymer of claim 19, wherein $n=1, 2$ or 3 .
29. The copolymer of claim 19, wherein said initiator species corresponds to an organic ether, an organic ester, an organic alcohol and an organic halide.

30. The copolymer of claim 19, wherein said initiator species corresponds to 2,4,4-trimethylpentyl chloride or tert-butyl-dicumylchloride.

31. The copolymer of claim 19, wherein said capping species corresponds to a substituted or unsubstituted diphenyl ethylene species.

32. A method of making the block copolymer of claim 10, comprising:

(a) providing a carbocationically terminated polymer comprising said one or more olefin blocks;

(b) contacting under reaction conditions said carbocationically terminated polymer with a capping species that does not homopolymerize under said reaction conditions, thereby forming an end-capped carbocationically terminated polymer; and

(c) contacting said end-capped carbocationically terminated polymer with protected hydroxystyrene monomer species under reaction conditions having lower Lewis acidity than the reaction conditions of step (b), thereby providing a block copolymer.

33. The method of claim 32, wherein the Lewis acidity in step (b) comprises TiCl_4 , and wherein the Lewis acidity in step (c) is lowered by the addition of a titanium tetraalkoxide species.

34. The method of claim 32, wherein said reaction conditions comprise a temperature between -50°C and -90°C .

35. The method of claim 32, wherein said carbocationically terminated polymer is formed under reaction conditions from a reaction mixture that comprises: (i) a solvent system, (ii) monomer species selected from isomonoolefins containing 4 to 18 carbon atoms per molecule and multiolefins containing 4 to 14 carbon atoms per molecule, (iii) an initiator selected from an organic ether, an organic ester, an organic alcohol, and an organic halide, and (iv) a Lewis acid.

36. The method of claim 32, further comprising hydrolyzing at least a portion of the constitutional units in said block copolymer that correspond to said protected hydroxystyrene monomer species, thereby forming alcohol groups.